

but whether heterozygosis, or complementary action, is at work, our experience of cross-breding in general makes it practically certain that genetic factors of special classes only can have these properties, and no pains should be spared in identifying them. It is not impossible that such identification would throw light on the nature of cell division and of that meristic process by which the repeated organs of living things are constituted, and I have much confidence that in the course of the analysis discoveries will be made bearing directly both on the general theory of heredity and on the practical industry of breeding.

In the application of science to the arts of agriculture, chemistry, the foundation of sciences, very properly and inevitably came first, while breeding remained under the unchallenged control of simple common sense alone. The science of genetics is so young that when we speak of what it also can do we must still for the most part ask for a long credit; but I think that if there is full cooperation between the practical breeder and the scientific experimenter, we shall be able to redeem our bonds at no remotely distant date. In the mysterious properties of the living bodies of plants and animals there is an engine capable of wonders scarcely yet suspected, waiting only for the constructive government of the human mind. Even in the seemingly rigorous tests and trials which have been applied to living material apparently homogeneous, it is not doubtful that error has often come in by reason of the individual genetic heterogeneity of the plants and animals chosen. A batch of fruit trees may be all of the same variety, but the stocks on which the variety was grafted have hitherto been almost always seminally distinct individuals, each with its own powers of luxuriance or restriction, their own root-systems, and properties so diverse that only in experiments on a colossal scale can this diversity be supposed to be levelled down. Even in a closely bred strain of cattle, though all may agree in their "points," there may still be great genetic diversity in powers of assimilation and rapidity of attaining maturity, by which irregularities by no means negligible are introduced. The range of powers which organic variation and genetic composition can confer is so vast as to override great dissimilarities in the conditions of cultivation. This truth is familiar to every raiser and grower, who knows it in the form that the first necessity is for him to get the right breed and the right variety for his work. If he has a wheat of poor yield, no amount of attention to cultivation or manuring will give him a good crop. An animal that is a bad doer will remain so in the finest pasture. All praise and gratitude to the student of the conditions of life, for he can do, and has done, much for agriculture, but the breeder can do even more.

When more than fifteen years ago the proposal to found a school of agriculture in Cambridge was being debated, much was said of the importance of the chemistry of soils, of researches into the physiological value of foodstuffs, and of other matters then already prominent on the scientific horizon. I remember then interpolating with an appeal for some study of the physiology of breeding, which I urged should find a place in the curriculum, and I pointed out that the improvement in the strains of plants and animals had done at least as much—more, I really meant—to advance agriculture than had been accomplished by other means. My advice found little favour, and I was taken to task afterwards by a prominent advocate of the new school for raising a side issue. Breeding was a purely empirical affair. Common sense and selection comprised the whole business, and physiology flew at higher game. I am, nevertheless, happy now to reflect that of the work which is making the Cambridge School of Agriculture a force for progress in the agricultural world the remarkable researches and results of my former colleague, Prof. Biffen, based as they have been on modern discoveries in the pure sciences of breeding, occupy a high and greatly honoured place.

In conclusion, I would sound once more the note with which I began. If we are to progress fast there must be no separation made between pure and applied science. The practical man with his wide knowledge of specific natural facts, and the scientific student ever seeking to find the hard general truths which the diversity of Nature hides—truths out of which any lasting structure of progress must be built—have everything to gain from free inter-

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change of experience and ideas. To ensure this community of purpose those who are engaged in scientific work should continually strive to make their aims and methods known at large, neither exaggerating their confidence nor concealing their misgivings,

"Till the world is wrought
To sympathy with hopes and tears it heeded not."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Dr. Alex. Findlay, special lecturer in physical chemistry, is resigning his post in consequence of his acceptance of the chair of chemistry in the University of Wales at Aberystwyth.

Dr. Murray has resigned his post as assistant lecturer and demonstrator in chemistry, having been appointed head of the chemical and metallurgical department of Wolverhampton Technical School.

By the will of Dr. S. J. Gee, late physician to St. Bartholomew's Hospital, the sum of about 20,000*l.* is left to his daughter for life, with contingent remainder to the Royal College of Physicians, London, upon trust, so far as possible, to form a permanent endowment fund for the college.

THE winter session of the London (Royal Free Hospital) School of Medicine for Women will be opened on Monday, October 2, with an introductory address by Sir Henry Boulton, P.R.C.S., upon "Research in Medicine and Women in Medical Research." Mrs. Garrett Anderson, president of the school, will occupy the chair.

MR. T. HARRIS, of the Imperial College of Science and Technology, and the Cavendish Laboratory, Cambridge, has been appointed lecturer and demonstrator in the physical department of the East London College in succession to Mr. E. Marsden. Mr. P. Kemp has been appointed lecturer in the electrical engineering department of the same college.

THE exchange of professors between Harvard University and the Ministry of Public Instruction in France comes into effect this winter for the first time, and the Bulletin of the American Geographical Society announces that Prof. W. M. Davis will go to Paris to lecture until the end of March, after the International Congress at Rome has ended. Prof. Diehl, of the Sorbonne, will go to Harvard University to lecture on Byzantine history.

A SPECIAL course of twelve lectures on illumination is to be given at the Polytechnic, Regent Street, during the present session. The lectures, which will be under the supervision of Mr. L. Gaster, editor of *The Illuminating Engineer*, will deal with all illuminants, including recent advances in electric, gas, oil, and acetylene lighting; the effect of light on the eye; the hygienic aspects of illumination; and the measurement of light and illumination. Practical problems, such as the lighting of schools, streets, and factories, will be treated in the second half of the course, commencing in January, 1912. Until December 5 the lectures will be held on Tuesday evenings at 7.30, and during January and February next on Thursday evenings at the same hour.

THE new session in the faculties of arts, laws, science, engineering, and medical sciences at University College, London, will begin on October 2. The list of public introductory lectures at the college contains the following, among others:—Wednesday, October 4, Prof. H. R. Kenwood on "The Scope of School Hygiene and the Legislative Provisions dealing with the School Child," being the first of a course of lectures on school hygiene specially designed for school teachers; Friday, October 6, Prof. G. Dawes Hicks on "Bergson's Conception of Creative Evolution" (this lecture is designed as an introduction to a course of four public university lectures to be delivered by Prof. Henri Bergson at University College on October 20, 21, 27, and 28). A course of public lectures on heating and ventilating engineering will be given by Mr. A. H. Barker, the introductory lecture on Tuesday, October 17, being on "Problems in Heating and Ventilation awaiting Solution by the Engineer." On the same day Mr. E.

Kilburn Scott, the newly appointed lecturer on electrical design, will begin his course on that subject.

A REVISED scheme of examination for inspectorships of mines has just been issued. The appointments are made after a competitive examination of candidates nominated by the Home Secretary. Each candidate must hold a first-class certificate under the Coal Mines Regulation Act, and must, within five years previous to his application, have been employed for two years as manager or under-manager of a coal mine, or in some other responsible capacity requiring regular attendance underground in a coal mine. Practical knowledge and experience of metalliferous mining and quarrying will also be taken into consideration. Candidates must be between twenty-three and thirty-five years of age at the time of examination. The revised subjects of examination are:—(1) English; (2) elementary mathematics; (3) elementary geology; (4) coal mining; (5) ore and stone mining; (6) electricity in mines; (7) law relating to mines and quarries; (8) oral examination; (9) chemistry; (10) physics. The last two are optional. The latest date for the return of the filled-up nomination form relative to the next appointments is October 15. Forms of application and full particulars can be obtained from the Private Secretary, Home Office, London.

THE seventeenth volume of reports, for the academic year 1909-10, from the universities and university colleges which participate in the annual grant made by Parliament for "University Colleges in Great Britain," and from the three colleges in Wales which receive a grant, has been published as a Blue-book (Cd. 5872). For the financial year 1909-10 the amount of grant paid by the Treasury to university colleges in England was 96,100*l.*, and for the year 1910-11, 101,250*l.* In the year 1909-10, 15,000*l.* was added to the annual grant in aid of university education in Wales. An introduction to the reports signed by the President of the Board of Education enumerates the private benefactions in aid of university education in this country made during the year under review, which have been announced from time to time in these columns. Apart from the recent munificent gifts to Reading University College, these benefactions were not comparable in magnitude or importance with those recorded in the previous report. The introduction goes on to say:—"The small extent to which university work is endowed by private benefaction in this country is emphasised, if comparison is made with the measure of support in other countries. Thus, within a year of its foundation the Kaiser Wilhelm Society for the promotion of science in Germany had at its disposal a capital of half a million sterling, which is being devoted to the equipment of institutes at which men already eminent in their respective subjects will be installed. In France, M. Auguste Lautreuil left 284,000*l.* towards the promotion of science in that country. In the United States Mr. Rockefeller handed over 764,000*l.* to the Rockefeller Institute for Medical Research, which he had previously endowed with large sums. These three instances are sufficient to show how small is the endowment of research in this country as compared with others, and from what a disadvantage this country inevitably suffers in the advancement of learning and research, now more than ever before essential to the welfare and prosperity of the nation."

THE reports referred to in the above note show that nearly 33 per cent. of the income of the English colleges was derived from fees, about 15 per cent. from endowments, a little more than 14.5 per cent. from grants from local education authorities, and 28 per cent. from the Exchequer. In the case of Welsh colleges, nearly 25 per cent. of their total income was derived from fees, nearly 6 per cent. from endowments, 6 per cent. from local education authorities, and 53.5 per cent. from the Exchequer. As a result of an increased Treasury grant the total annual income of the Welsh university colleges rose from 50,000*l.* to about 65,000*l.* The total number of students of all kinds for 1909-10 was returned as 22,187 in England (of whom 8174 were full-time students) and 1710 for Wales. No students taking courses for matriculation have been included amongst the full-time students. The total numbers of degree students in England rose from under 400 to nearly 4900. In Wales the numbers in-

creased from 1175 to 1191. The number of post-graduate students in the English universities and colleges concerned grew from 1052 to 1255, while in Wales it fell from 45 to 37. The number of part-time students of all kinds in England reached the figure of more than 13,700. Only about 1200 of these were reading for degrees or attending post-graduate courses.

THE new calendar of Armstrong College, Newcastle-upon-Tyne, directs attention to the fact that the faculty of science in the University of Durham is seated entirely at Armstrong College. In addition to pure science the college gives instruction in engineering (mechanical and civil), electrical engineering, mining, metallurgy, naval architecture, and agricultural science. The agricultural department of the college directs the Northumberland County Agricultural Experimental Station at Cockle Park, and the Durham County Station for Dairy Research at Offerton Hall. For the purpose of forestry instruction the college is in possession of 900 acres of wood at Chopwell, in the county of Durham, and its zoological equipment includes a laboratory of marine biology at Cullercoats, on the Northumbrian coast. Amongst prospectuses of technical institutes which have reached us may be mentioned those of the Sir John Cass Technical Institute, Aldgate, and the Northern Polytechnic Institute, Holloway. At the Sir John Cass Institute several new departures are being made. The curriculum of students in the fermentation industries now includes courses on "Brewing and Malting" and the "Micro-Biology of the Fermentation Industries." In the physics department, lectures and demonstrations will be given on "colloids," which will deal with their relation to technical problems. The special courses on liquid, gaseous, and solid fuel in the metallurgy department have also been extended, and will include laboratory work of fuel analysis and on gas analysis. There are also special features in the work of the Northern Polytechnic, and one of importance is the day school of building, which provides a practical course of training for those about to enter any profession or business connected with the construction of buildings, with surveying or with municipal engineering. The course of work in the school provides instruction in both the principles and processes of building work, and should be of interest to parents who intend to place their sons in the architectural or surveying professions, and to builders whose sons are destined to take a future share in the management of a business.

THE eighth report of the Commissioners for the Exhibition of 1851 to the Home Secretary has been issued as a Blue-book [Cd. 5723]. The last report was published in 1889. The report proper runs to some twenty-six pages, the remaining part of the volume of 132 pages being given over to appendices, which include copies of leases, the charter of the Imperial College of Science and Technology, general regulations, accounts, and so on. Full details are given of the various steps taken by the commissioners to carry out their object of forming a centre at South Kensington for institutions engaged in the promotion of science and art, and more especially in their application to industry. As regards the consideration of future policy, the commissioners say:—"When we became free from the encumbrance of a heavy mortgage debt we were enabled to devote a considerable portion of our income to scholarships for scientific research. The remainder has been invested from time to time, so that we are now in a position to increase the scope of our activities. We have accordingly considered the uses to which we should apply our funds in the immediate future. It is not contemplated to disturb the existing provision of scholarships for purposes of research; but in our opinion a point has been reached when the capital resources of the commission should no longer be applied to assist in the erection of buildings at South Kensington, and when the balance of the income derived from our present funds should be so used as to give a further impetus to scientific and artistic training consistent with the objects of our charter. We believe that our income can be used to great advantage by the provision of scholarships and bursaries endowed, not for all time, but for limited periods, and directed specially to encourage not only research work, but also the training of 'captains of industry.' We shall, moreover,

endeavour to include in any extension that we may hereafter devise for our scheme of scholarships some provision for encouraging the study of the fine arts on lines corresponding to those which have proved so efficacious in relation to science and its applications. In such assistance as we may afford from time to time to the solution of problems affecting the industrial welfare of the nation, we shall have regard principally to schemes which from their nature require support from other than ordinary sources."

THE first part of the Board of Education statistics of public education in England and Wales for the school year 1909-10, dealing with educational statistics, has been published (Cd. 5843). In his preface Sir Robert Morant points out that the Board has not for the year under review been able to make any substantial change in the statistics of technical institutions, evening schools, and allied classes. It is hoped, however, that when the proposed new regulations have come into operation, it will be possible to provide a series of tables relating to "further education," in which the various types of schools will be more clearly differentiated than is at present possible. As regards technical institutions—that is to say, institutions giving an organised course of instruction in day classes, including advanced instruction in science, or in science and in art, and provided with a staff and equipment adequate for the purpose and fulfilling other requirements laid down by the Board—there were 35 recognised during the year; and they provided 124 courses in which 736 teachers were employed. The number of students who attended at any time during the year was 2946, and on 2584 of these grants were paid by the Board. Of these 2946 students, 190 were under 16 years of age, 735 under 18 but over 16, 1284 over 18 but under 21 years of age, and 737 were over 21. In addition to these students of technical institutions there are many other students studying science and technology in day technical classes. In a series of tables the Board provides information of 230 courses held in 109 institutions in which day technical classes were recognised, but points out that "the 'day technical classes' to which the following tables relate constitute merely a small fraction of the whole number of day technical classes in existence in England." In the 230 courses mentioned there were 10,924 students taught by 983 teachers.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 4.—M. Armand Gautier in the chair.—Kr. **Birkeland**: The electrical constitution of the sun. A development of views put forward in two earlier communications. The photosphere is regarded as a sea of electric arcs. The bearing of these views on Laplace's nebular hypothesis is discussed, since, if matter is radiated under the action of electrical forces, it is not necessary to assume that at one time the nebula extended to the orbit of Neptune, and this reduces the force of Moulton's objections to Laplace's theory.—M. **Merlin**: Some theorems of arithmetic and an enunciation which contains them. Henri **Villat**: A mixed problem of the theory of harmonic functions in an annular area.—Ed. **Griffon**: A singular case of variation by budding in the peach tree. A description of the appearance of shoots of almond, bearing blossom, on a peach tree.—Marcel **Baudouin**: Human post-mortem actions on the human bones in the bone caves of the polished stone period.—Stanislas **Meunier**: An Egyptian meteorite recently presented to the museum. This meteorite appears to belong to a new lithological type, and will be described in detail in a later communication.

September 11.—M. Armand Gautier in the chair.—Émile **Picard**: An addition to a theorem relating to integral equations of the third species.—Armand **Gautier**: The mechanism of the variation of race, and the molecular transformations which accompany these variations.—A. **Korn**: An important class of asymmetrical nuclei in the theory of integral equations.—Tr. **Lalesco**: Theorem on characteristic values.—L. E. J. **Brouwer**: The theorem of M. Jordan in space of n dimensions.—A. **Blondel**: The various methods of measuring orientation in wireless telegraphy.—C. **Statescu**: Solutions of heterogeneous mag-

netic salts in a heterogeneous magnetic field.—P. **Mahler** and E. **Goutal**: The use of combustion under pressure for estimating carbon in steel. A modified calorimetric bomb, not enamelled, and having a capacity of 1 litre, has been used for the direct combustion of iron and steel in oxygen under a pressure of 25 atmospheres. The carbon dioxide produced is absorbed in a standard solution of baryta. The method is shown to compare favourably, as regards accuracy, with the usual methods, and has the advantages of rapidity and ease of execution.—Paul **Villemin**: Mutation of a hybrid transmitted to its descendants.—E. **Roubaud**: The Chæromyies, a new Diptera with larvæ sucking the blood of mammals.—H. **de Dorlodot** and Ach. **Salée**: The synchronism of the Carboniferous limestone of the Boulonnais with that of Belgium and England.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part ii. for 1911, contains the following memoirs communicated to the society:—

January 14.—C. **Runge**: The radio-activity of air from the open sea.

February 25.—H. **Weyl**: The asymptotic distribution of particular solutions in integral equations.—G. **Angenheister** and C. **Rohloff**: Meteorological observations in the South Seas, from the Samoa Observatory.

March 11.—R. **Gans**: The electron theory of ferromagnetism, ii.—G. **Tammann**: The alterations in the properties of metals due to mechanical treatment.

The Business Communications of the society, part i. for 1911, contain the ninth report on the publication of Gauss's works, and the tenth report of the Samoa Observatory for 1910-11.

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